INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

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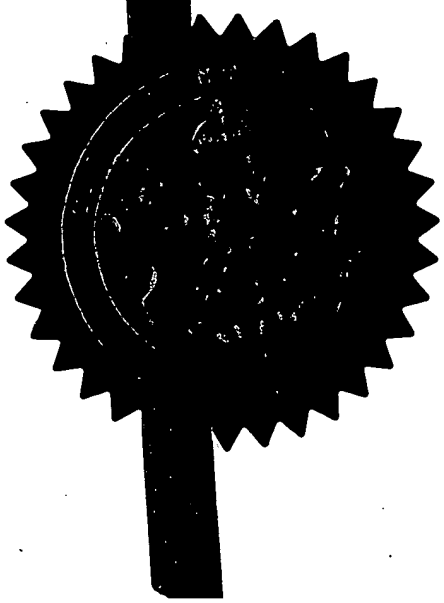

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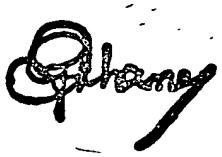
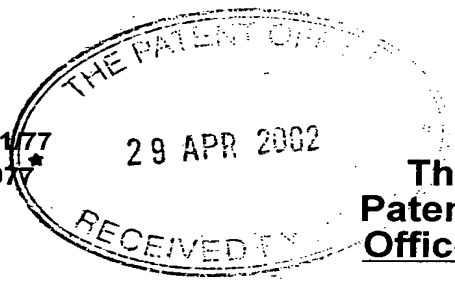
PRIORITY DOCUMENT

Signed 

Dated 18 March 2004

Patents Form 1/77
Patents Act 1977
(Rule 16)



The Patent Office

30APR02 E714804-1 002611
P01/7700 0.00-0209781.4

Request for grant of a patent

The Patent Office
Cardiff Road
Newport
South Wales NP10 8QQ

1. Your reference
1876901/AM

2. Patent Application Number 29 APR 2002 **0209781.4**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Scientific Generics Limited
Harston Mill
Harston
Cambridgeshire
CB2 5GG

Patents ADP number *(if known)* 07976296002

If the applicant is a corporate body, give the country/state of its incorporation — Country: **ENGLAND** State:

4. Title of the invention

LOCATION MEASUREMENT SYSTEM

5. Name of agent — **Beresford & Co**

"Address for Service" in the United Kingdom to which all correspondence should be sent

2/5 Warwick Court
High Holborn
London WC1R 5DH

Patents ADP number 00001826001

6. Priority details

Country	Priority application number	Date of filing

Patents Form 1/77

7. If this application is divided or otherwise derived from an earlier UK application give details

Number of earlier application | Date of filing

8. Is a statement of inventorship and or right to grant of a patent required in support of this request?

YES

9. Enter the number of sheets for any of the following items you are filing with this form.

Continuation sheets of this form	
Description	3
Claim(s)	
Abstract	
Drawing(s)	

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents form 7/77)*	**1 + 2 COPIES**
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for Substantive Examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application

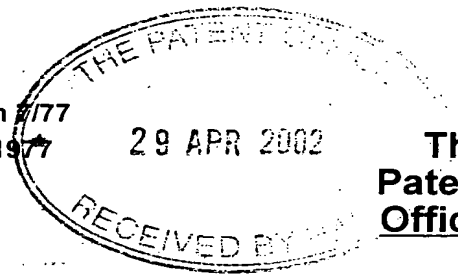
Signature Beresford & Co BERESFORD & Co Date 29 April 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

ALAN JOHN SHAW MACDOUGALL

Tel: 020 7831 2290

Patents Form 7/77
Patents Act 1977
(Rule 15)



The Patent Office

Statement of inventorship and of right to grant of a patent

The Patent Office
Cardiff Road
Newport
South Wales NP10 8QQ

1. Your reference
1876901/AM

2. Patent Application Number
accompanying application reference 1876901
29 APR 2002
0209781.4

3. Full name of the or each applicant

Scientific Generics Limited

4. Title of the invention

LOCATION MEASUREMENT SYSTEM

5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent

BY VIRTUE OF EMPLOYMENT.

6. How many, if any additional Patents Forms 7/77 are attached to this form?

NONE

7. I/We believe that the person(s) named over the page (and on any extra copies of this form) is/are the inventor(s) of the invention which the above patent application relates to.

Signature Beresford & Co
BERESFORD & Co

Date 29 April 2002

8. Name and daytime telephone number of person to contact in the United Kingdom

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Patents Form 7/77

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location measurement system

Background

Current location measurement systems, for example the phase based measurement system described in patent application GB01/05029, suffer from errors caused by static multipath. When the tag that is to be tracked falls into a region of strong reflections it is more likely to find the reflections than any direct line of sight signal and thereby the calculation of time of flight will be incorrect. Most multipath mitigation techniques currently in use rely on hardware changes to the system (for example the use of circular polarisation or spread spectrum) or software additions (for example averaging over time or other knowledge constraining the location of the tag). This invention allows for the static multipath to be measured and calibrated.

Invention

The invention will be described in the embodiment of its use for the phase based location and tracking system described in patent application GB01/05029. The mobile tag transmits multiple tones on a carrier frequency that are detected at multiple receiver base stations. The phase difference between these tones are used to calculate the relative position of the mobile tag. By using multiple tones with varying phase difference it is possible to produce a system that allows coarse to fine measurement, which overcomes the cyclical ambiguity arising from the phase difference measurement. This system already describes a method for synchronising the base stations using reference tags that are located in known positions. This will allow the base stations to operate remotely without the need for further synchronisation making the system much easier to deploy. Figure 1 is a schematic representation of this system.

A modification of this system is described here where more reference tags are deployed in and around the tracking area. These fixed reference tags can be used to calibrate the system for any static multipath. Static multipath is defined here to mean any multipath that is consistent over a period of time longer than the measurement cycle. For example, a system that updates the location of mobile tags ten times a second could operate with a static multipath measurement of 10 seconds or so. This allows for large objects being placed in the field during the tracking event, for example a television crew vehicle and so on. To those skilled in the art it is seen that this time scale can be of arbitrary length. Short time scale, local multipath and other short term errors in the reference tags require higher update rates and will be prone to more errors making the calibration more inaccurate and therefore, while it is still possible to attempt to correct these errors the preferred embodiment of this invention allows only for longer term correction (approximately ten times higher than the update rate for the location calculation).

Figure 2 represents a race course around which tracking of a mobile tag is to be carried out. The grey line represents the tracked position of the mobile tag. As can be seen the metal fence located at the top of the track produces a substantial static

multipath effect that pushes the location of the tracked mobile away from the oval. This effect is also observed in the presence of building structures such as a grandstand, hedges or hills. By deploying a few fixed reference tags near to the oval around the top of the track it would be possible to measure the static multipath and produce a multiplication matrix that would map the calculated position into the actual position of a mobile tag. This mapping could be done as part of the tracking procedure in real time or could be applied at a later date if the system does not need to display the data in real time.

Those skilled in the art will appreciate that the calibration can be done continuously while the tracking of the mobile device is carried out or could be part of a set up procedure of the system and the fixed reference tags could then be removed. The removal of the fixed reference tags will result in any changes in the static multipath not being corrected.

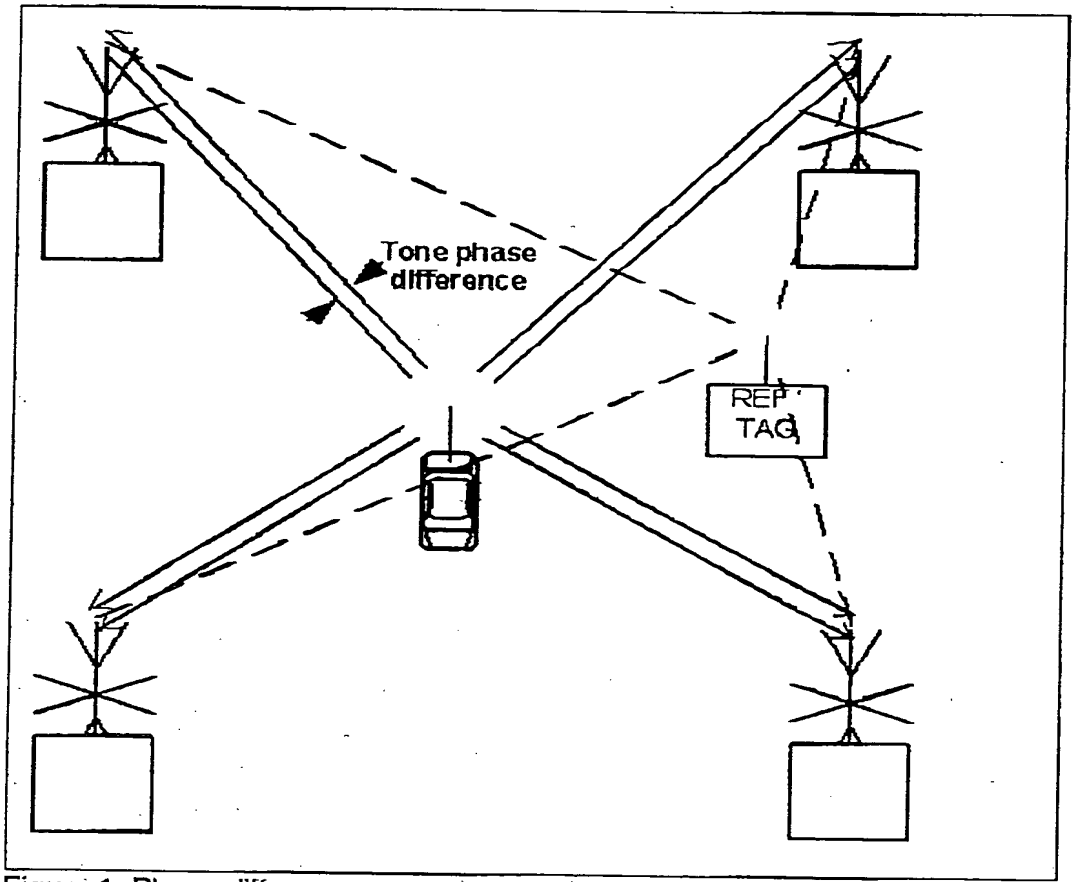

Figure 1: Phase difference measurement system described in patent application GB01/05029. The four base stations receive signals from the fixed tags as well as the mobile tag.

By placing reference tags around the course any changes anywhere will be automatically corrected. An additional benefit of this invention is that it simplifies the placement of the tracked location onto a graphical representation of the course.

In this horse racing example, these additional reference tags can be placed on known locations. For example, they could be placed on the rail that defines the course or the posts used for measuring the distance the horses have raced. This allows automatic calibration of the system with minimal user interface and so those skilled in the art of location technologies are not required for the deployment.

Any application where the mobile tags are to be tracked within a confined area, smaller than the overall coverage area, can benefit from this technique.

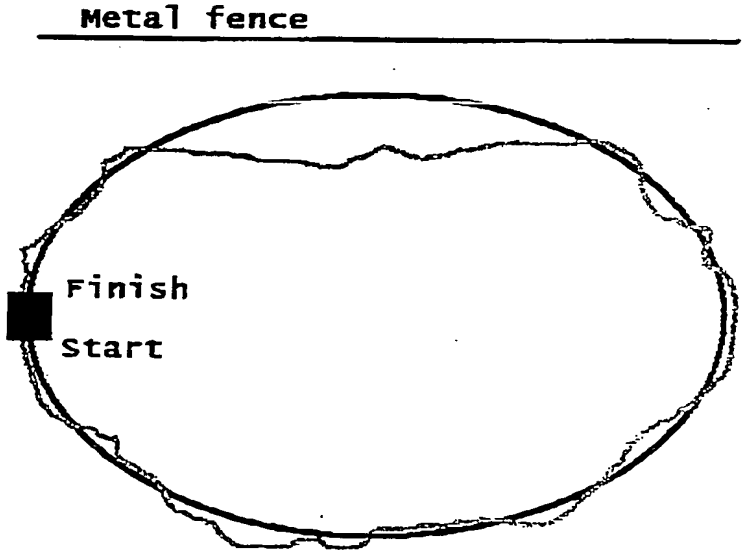

Figure 2: The oval represents a race course around which tracking of a mobile tag is to be carried out. The grey line represents the tracked position of the mobile tag. As can be seen the metal fence located at the top of the track produces a substantial static multipath effect that pushes the location of the tracked mobile away from the oval.

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